X-ray Spectroscopy at the Metal-Insulator Transition in $(V,Al)_2O_3$	X23B

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V_2O_3, a metallic paramagnet at high temperature and an insulating antiferromagnet below $T_{MI} = 170$ K, undergoes a structural transformation from the high temperature trigonal phase into a monoclinic phase, accomplished by a decrease in the c/a ratio (axes referred to the trigonal phase) and a tilt, by 1.9° with respect to the high temperature phase c-axis, of two of the three V pairs which occupy the octahedral sites. Whether the structural transition drives the electronic one, or vice-versa, is not known, but potentially very important to understanding the mechanism of this metal-insulator transition (MIT). In this context, it is noteworthy that doping V_2O_3 with Cr or Al can also cause a metal-insulator transition, but one which does not change the lattice symmetry. Recent experiments cast some doubt on the importance of the trigonal to monoclinic distortion for the MIT. O K edge NEXAFS measurements on pure and Cr doped V_2O_3 single crystals in the metallic and insulating phases show the local electronic structure of the Cr doped trigonal insulating phase and the low temperature monoclinic phase are the same, while EXAFS measurements show a monoclinic distortion on a microscopic scale in the room temperature metallic phase of pure V_2O_3 although the average structure is trigonal. There are two possible interpretations: (i) The monoclinic distortion is irrelevant to the MIT in pure V_2O_3, since the trigonal Cr doped insulating phase shows the same local electronic structure, or (ii) a monoclinic distortion is also present in the Cr doped insulating phase. To decide between these possibilities we have measured the V K edge x-ray absorption spectra of V_2O_3 single crystals, both pure and doped with Al (rather than Cr, to avoid interference with the V edge). On these single crystals, we have measured in fluorescence yield; this may introduce distortions due to self-absorption, which we have corrected by measuring spectra at several sample geometries and comparing to an explicit calculation.We show in Fig. 1 the EXAFS spectra of a V_2O_3 as measured at several exit angles. The apparent amplitude differences caused by self-absorption are removed by the correction procedure. Although analysis of the extended fine structure is not yet complete, the spectra depend very clearly on the polarization between the incident beam and the single crystal samples. An example is shown in Fig. 2, in which the extended fine structure, transformed into R space, is shown for the incident polarization parallel and perpendicular to the sample c axis.

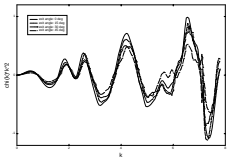

Figure 1. Fluorescence EXAFS on V_2O_3 as measured at a variety of exit angles. Differences are the result of self-absorption.

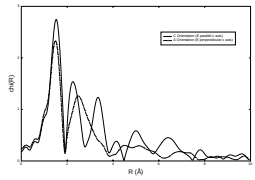

Figure 2. EXAFS transform on single crystal V_2O_3 at two orientations as indicated.